

Efficacy of Carotid Artery Stenting

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Summary

Carotid Artery Stenting (CAS) was performed for 51 lesions in 46 patients for almost clinically symptomatic stenotic (>70%) lesions of cervical carotid arteries. The lesions involved the contralateral occlusion cases in eight cases, the bilateral stenotic cases in six cases and the ipsilateral internal carotid artery stenotic cases in two cases. In all cases, endovascular technique was performed from a transfemoral approach under local anesthesia primarily. Under systemic heparinization, CAS was performed using a self-expanding stent system. For the pre-stenting and post-stenting dilatation, percutaneous transluminal angioplasty (PTA) balloon catheters were used. The balloon was inflated up to the pressure of six to ten atmos for 20 to 30 seconds. After CAS, stenotic lesion dilated successfully in all cases (0-20% residual stenosis; mean, 5.5%) even if in the case of the contralateral occlusion cases, more than 90% severe stenotic cases, and the tortuous artery cases. The cerebral protection system was always used, mainly distal blocking balloon type. Only one symptomatic complication occurred after CAS. Follow-up ultrasonic carotid echogram was performed in 30 cases. No cases showed restenosis (more than 50% restenosis). Clinical follow up was performed in all cases for one to 41 months (mean, 15.2 months) and no clinical deterioration such as TIA or stroke occurred. CAS is technically feasible and

can be performed with relatively low morbidity even if complicated stenotic cases. It may be useful, but the increase the number of patients and the long-term follow-up are necessary to evaluate the safety and usefulness of this method.

Introduction

Severe carotid artery stenosis is one of the most common causes of ischemic cerebrovascular accidents. Carotid endarterectomy (CEA) has been performed as a standard treatment for a long time to prevent of this stroke. But recently advances in the devices and techniques of intravascular neurosurgery, percutaneous carotid artery stenting (CAS) with the use of an emboli-protection device can be performed safely for the treatment of symptomatic stenotic lesions of the carotid artery¹⁻⁵. This report presents our results for CAS and discuss the advantages and the problems of this treatment, especially in the case of the contralateral occlusion cases, more than 90% severe stenotic cases, and the tortuous artery cases to prevent complication and for more safety procedures.

Materials and method

From April 2002 to July 2005, CAS was performed for 51 lesions in 46 patients of the stenosis of the cervical carotid arteries, and all of the cases were followed for one month to 41

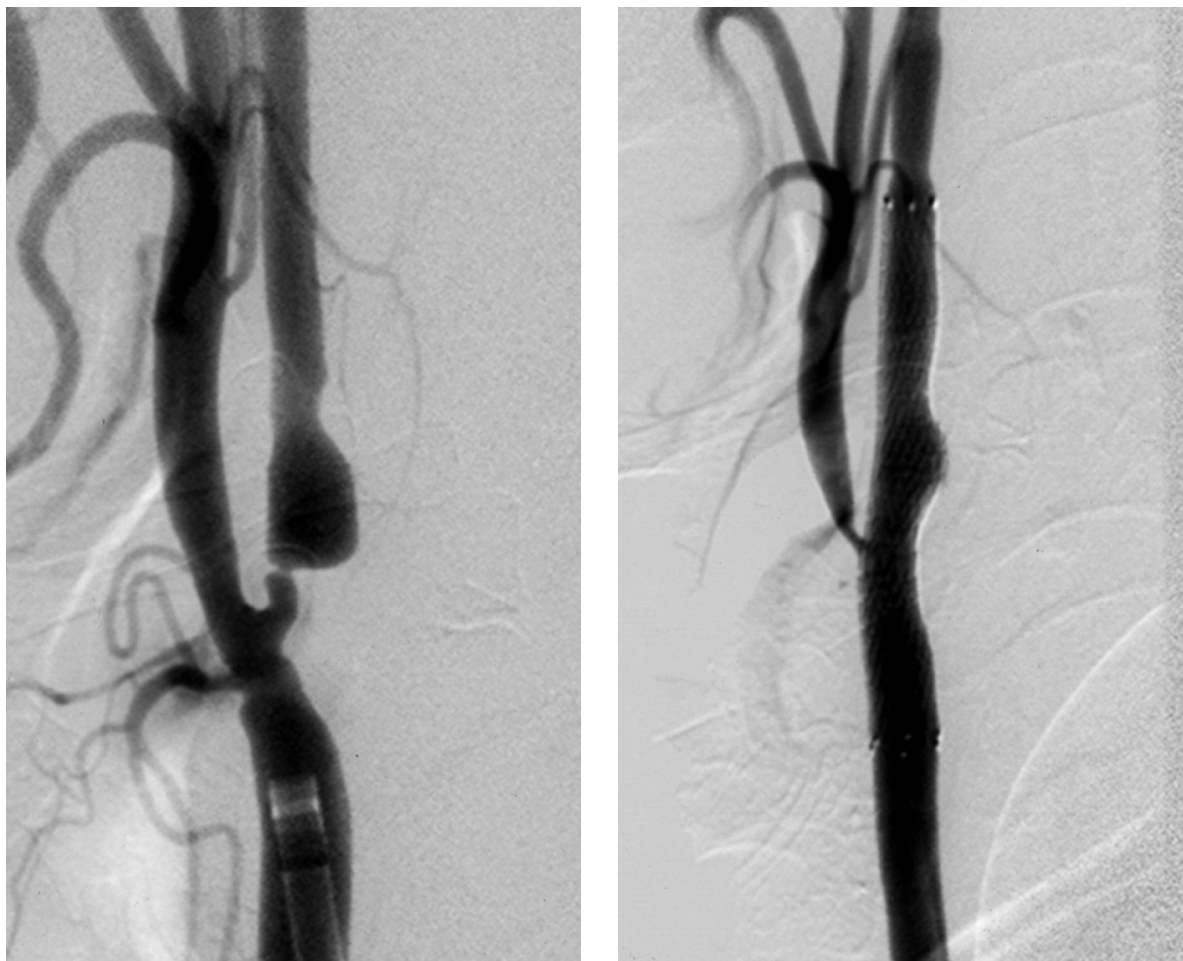


Figure 1 Contralateral carotid occlusion case. Lateral view of the right carotid angiogram before (left) and after (right) CAS in the case of left carotid occlusion case. The 90% stenosis initially observed decreased to 0% after CAS.

Table 1 Baseline patient characteristics of 51 lesions in 46 cases of Carotid Artery Stenting(CAS).

	N
Age/years	24-81 (71.1)
Men/Women	39/7
Stenosis %	70-99(80.9)%
Contralateral carotid occlusion	8
Bilateral carotid stenosis	6
Ipsilateral distal stenosis	2
Previous ipsilateral CEA	2
Previous neck radiation therapy	1
Previous neck trauma	1

Table 2 Results of 51 lesions in 46 cases of Carotid Artery Stenting (CAS).

	N
Angiographical success	51
Post CAS stenosis %	0-20(5.5)%
Procedure related complication	1
Morbidity / Mortality N (%) / N	1(1.9%) / 0
Follow-up clinical	46
Clinical deterioration (TIA or stroke)	0
Follow-up carotid echogram	30
Restenosis (more than 50%)	0



Figure 2 More than 90% stenotic case. Lateral view of the right carotid angiogram before (left) and after (right) CAS in the case of more than 90% stenotic case. The 95% stenosis initially observed decreased to almost 0% after CAS.

months with a mean of 15.2 months after the CAS procedure. The age of the patients varied from 24 to 81 years, with a mean of 71 years, and included 39 males and seven females. The lesions involved the contralateral occlusion cases in eight cases, the bilateral stenotic cases in six cases, and the ipsilateral internal carotid artery stenotic cases in two cases. Almost all cases were symptomatic, such as TIA or minor stroke, and the degree of stenosis ranged from

70 to 99 percent, with a mean of 80.9 percent. CAS was performed under local anesthesia, and with DSA control using the road map function. The patient was fully heparinized and ACT monitoring was used. For the pre-stenting and post-stenting dilatation, PTA balloon catheters of 3 to 6 mm in diameter were used. The balloon was inflated to a pressure of six to ten atmospheres for 20 to 30 seconds. After pre-stenting PTA, CAS was performed using a



Figure 3 Tortuous artery case. Lateral view of the left carotid angiogram before (left) and after (right) CAS in the case of tortuous case. The 95% stenosis initially observed decreased to 5% after CAS.

self-expanding stent system e.g. SMART, Precise (Cordis J&J Inc.), Wall RP (Boston Scientific Inc.) and Expert (Abbott Inc.). And post-stenting angioplasty was performed if needed. The cerebral protection system was always used, mainly distal blocking balloon type e.g. Guard Wire Percu-Surge (Medtronic Inc.). After CAS, systemic heparinization continued for 24 hours, and antiplatelet therapy continued before and after CAS.

Results

As shown in the table 1, initial stenosis ranged from 70 to 99 % with a mean of 80.9%. Technical success was achieved in all cases. After the CAS, stenosis ranged from 0 to 20%, the

mean being 5.5%. Regarding the clinical results, only one symptomatic complication occurred after the CAS because of distal embolism during the procedure, but got improved her symptoms and recovered almost fully activity of daily life. This was the only one symptomatic complication we encountered in this study.

In the case of the contra-lateral occlusion cases, more than 90% severe stenotic cases, and the tortuous artery cases, we had no special complicative event. Total morbidity rate was 1.9% and mortality rate was 0%. Follow-up ultrasonic carotid echogram was performed in 30 cases after the CAS. No cases showed re-stenosis (more than 50% re-stenosis). Clinical follow-up was performed for one to 41 months with a mean of 15.2 months, and no clinical de-

terioration such as TIA or stroke occurred. But the activity of daily life of two patients got worse because of non-periprocedural event, gastric cancer and new intra-cerebral hemorrhage. (table 2)

Representative cases

Contralateral carotid occlusion case

This 71-year-old male suffered from left hemiparesis. An angiogram showed the left IC occlusion and 90% of stenosis of the right carotid IC bifurcation. CAS was performed for the right IC stenosis using the 6.0 mm X 4 cm SMART Stent with Percu Surge protection system. The 90% stenosis initially observed decreased to almost 0% after CAS. After CAS, the patient improved gradually.

More than 90% stenotic case

This 80-year-old male suffered from left hemiparesis and hemidysesthesia. An angiogram showed the right IC 95% stenosis. CAS was performed for the right IC stenosis using the 8.0 mm X 4 cm SMART Stent with Percu Surge protection system. The 95% stenosis initially observed decreased to almost 0% after CAS.

Tortuous artery case

This 75-year-old male suffered from RIND. An angiogram showed the left tortuous IC 95% stenosis. CAS was performed for the left IC stenosis using the 8.0 mm X 4 cm SMART Stent after making straightened the direction

Table 3 Summary of contralateral occlusion cases

	N
Case number	8
Age/years	24-77 (67.3)
Men/Woman	7/1
Stenosis %	70-98 (85.9) %
Post CAS stenosis %	0-20 (5.0) %
Angiographical success	8
Clinical success	8
Intraoperative temporary symptom	5
Procedure related complication	0
Morbidity / Mortality	0 / 0

of IC with Percu Surge protection system. The 95% stenosis initially observed decreased to almost 5% after CAS.

Discussion

The procedure of CAS has many advantages, especially compared to surgical procedure such as endarterectomy. Because of local anesthesia we are able to monitor the patient's neurological state and consciousness. Because of not direct surgery we are able to continue anticoagulant and antiplatelet therapy. And we can get adequate orthograde cerebral blood flow during the procedure. On the other hand, we have some perioperative problems that may be en-

Table 4 Correlation of intraoperative ischemic symptom and collateral flow.

No	age	sex	side	symptom	A-com	P-com	EC	VA
1	77	M	Rt.	precoma	-	+	+	+
2	71	M	Rt.	-	-	++	+	-
3	71	M	Lt.	precoma	-	-	+	+
4	72	M	Rt.	-	-	++	+	-
5	67	M	Rt.	aphasia	-	-	-	-
6	76	M	Lt.	precoma	+	-	-	-
7	75	M	Lt.	paresis	-	-	-	-
8	24	F	Rt.	-	-	++	+	-
(Collateral flow: (-): none, (+): mild, (++) : rich)								

countered including distal emboli, dissection, and acute occlusion. But the biggest problem of CAS is that insufficient data on the effectiveness, frequency of complication and long-term follow-up has yet to be collected. Recently Yadav et al. reported that carotid artery stenting (CAS) with the use of an emboli-protection device is not inferior to carotid endarterectomy⁶. After this report the number of CAS procedure is getting bigger and bigger. In this our report we presented our results of CAS and showed the advantages and the usefulness of this treatment.

In the case of the contra-lateral occlusion cases, more than 90% severe stenotic cases, and the tortuous artery cases there's no difference of the results between these complicated cases and other ordinary stenotic cases. But we should manage more strictly to perform the CAS procedure for these high risk cases to prevent complication. As shown in the tables 3 and 4, in the case of the contra-lateral occlusion cases we should concern to the presence of collateral flow, especially flow from posterior communicating artery (P-com) is the most valuable. If there's very little or no collateral flow from P-com, patient does not have the tolerance of hypoperfusion with temporary IC blocking used Percu Surge. Therefore we have

to select the way of CAS procedure whether performing under local anesthesia with deep sedation or performing under general anesthesia or performing with selective protection procedure and so on. Before procedure it is absolutely necessary to evaluate case profiles and collateral flow to manage the risk factors and then to prepare the suitable devices for each situation. During CAS we have to follow the changing of neurological signs and the trend of patient's vital signs. After all of the procedures we should be dedicated ourselves to preventing cerebral infarction, cerebral hemorrhage and the bleeding around femoral puncture site.

Conclusions

From the results presented here, if we manage problems which we have before, during and after the CAS procedure, we may conclude that carotid artery stenting (CAS) of the extra cranial carotid artery reduces the stenosis and it can be performed with relatively low morbidity even if we perform the procedure in high risk cases. From our experience, it may be a useful procedure, but results from a larger number of patients and more long-term follow-up data are absolutely necessary in order to evaluate the safety and usefulness of this method.

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